BEFORE THE STATE OF WASHINGTON
ENERGY FACILITY SITE EVALUATION COUNCIL

IN RE APPLICATION NO. 99-1	)	
	)	EXHIBIT _____ (PWM-T)
SUMAS ENERGY 2 GENERATION FACILITY	)	
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PREFILED DIRECT TESTIMONY OF

NW ENERGY COALITION AND WASHINGTON ENVIRONMENTAL COUNCIL

WITNESS: PHILIP W. MOTE

I. INTRODUCTION

Q. Please state your name and business address.

A. Philip W. Mote, Joint Institute for the Study of the Atmosphere and the Oceans/School of Marine Affairs (JISAO/SMA) Climate Impacts Group, Box 354235, University of Washington, Seattle, WA 98195.

Q. By whom are you employed and in what position?

A. I am employed by the University of Washington as a research scientist/public information specialist with the Climate Impacts Group (CIG).

Q. Please summarize your education and academic experience.

A. I earned a B.A. in Physics (with honors) from Harvard in 1987 and a Ph.D. in Atmospheric Sciences from University of Washington in 1994. In my academic career I have written more than 20 scientific publications on topics related to climate and the dynamics of the atmosphere. Also, I was lead author of the 1999 report, "Impacts of climate variations and change on the Pacific Northwest" (Executive Summary provided in Exhibit PWM-1) and editor of a book entitled "Numerical modeling of the global atmosphere in the climate system," Kluwer Academic Publishers, May 2000.

Q. What are your current responsibilities for the JISAO/SMA Climate Impacts Group?

A. First, to conduct original disciplinary and interdisciplinary research on the variations and trends in climate in the Northwest, and the impacts of those variations and trends; also to integrate the results of the entire CIG. Second, I serve as principal point of contact in the CIG for media, natural resource managers, and the general public. Third, I design and

conduct workshops and seminars to inform managers of the results and applications of CIG research to natural resource management in the Northwest.

Q. Please state the issues you will address in your direct testimony.

A. In this testimony I will show that the consequences of climate change in the Pacific Northwest are likely to include both positive and negative changes. The most fundamental consequence for the region's ecosystems and human endeavors is likely to be the reduction in summer water supply caused by a diminishing snowpack. This is likely to have profound impacts on irrigated agriculture, forests, salmon, and hydropower, among other things.

II. CLIMATE CHANGE IN THE PACIFIC NORTHWEST

Q: What is the connection between climate change and burning fossil fuels, like coal, oil, and natural gas?

A: Burning fossil fuels produces carbon dioxide (CO_2). Carbon dioxide is one of many greenhouse gases, so called because they warm the Earth in a way somewhat analogous to a greenhouse. Because CO_2 is the most important long-lived greenhouse gas, my remarks will focus on CO_2. CO_2 is a natural constituent of the Earth's atmosphere, but the concentration of CO_2 in the atmosphere has risen about 30% since the beginning of the industrial revolution, largely because of the burning of fossil fuels. At this rate, there is little doubt that the CO_2 concentration will reach a value roughly double that of its pre-industrial concentration in 50-100 years. Given that CO_2 is a powerful greenhouse gas, such a huge increase in its concentration is very likely to change the Earth's average temperature and other aspects of Earth's climate. The direct testimony of Richard

Gammon (RHG-T) discusses in more detail how the burning of fossil fuels contributes to global climate change.

Q: How much scientific consensus is there that Earth's climate is changing as a result of the burning of fossil fuels?

A: The most comprehensive study of this question to date is the ongoing work of the Intergovernmental Panel on Climate Change (IPCC), which in its 1995 second assessment report concluded that "the balance of evidence suggests a discernible human influence on global climate." The IPCC's Working Group I, which is composed of hundreds of climate scientists, arrived at this conclusion after summarizing all relevant peer-reviewed publications on the issue, and having the document repeatedly reviewed by other scientists for accuracy. It is, therefore, the expert judgment of the international community of best-qualified scientists.

Q: Has the Pacific Northwest's climate changed in the last 100 years?

A: The Pacific Northwest (PNW) has warmed about 1.5 degrees Fahrenheit and precipitation has increased about 15% over the past 100 years. These estimates used stations with long records that have been quality-controlled by the National Climate Data Center; most go back at least to 1920, some to the 1880s. There were 113 stations reporting temperature and 76 reporting precipitation.

Q: Is it possible to attribute these climate changes to greenhouse gas emissions?

A: Scientists who study "attribution" of climate change (that is, testing whether a climate factor like solar radiation or CO_2 increases is consistent with the type of climate change detected) have applied their methods only to areas of the Earth much larger than the

PNW. Therefore, it is not possible to say with certainty what has caused the climate changes I just mentioned. However, climate models (computer programs that simulate global atmospheric and oceanic conditions) can give an idea of whether the changes are *consistent* with CO_2 increases. At CIG we have examined three climate model simulations of global climate from 1900 to the present, in which the climate models were fed information about past changes in CO_2. They did a fairly good job of simulating the observed changes. Two of the three models got temperature increases roughly similar to the observed changes, and they also got modest increases (though smaller than observed) in winter precipitation. None of them got the increases in summer precipitation. I have studied the potential contribution of changes in the Pacific Ocean (which affects our year-to-year climate) and concluded that those changes cannot explain the warming trend we have seen.

Another approach to answering this question is to reason by analogy. The decade-to-decade changes in PNW temperature are similar to those of the global temperature, which can be explained by a combination of natural causes and greenhouse gas emissions but not by natural causes alone.

Putting together these two lines of reasoning, it seems that greenhouse gases are the likeliest explanation of the observed warming in the PNW, but we cannot say that this connection has been satisfactorily established.

Q: How much will the climate of the Northwest change in the next 50 years?

A: Projections of future climate change rely on scenarios of future greenhouse gas emissions, which in turn depend on projections of things like future economic growth and

technological change. Such projections are very difficult and uncertain. One simple approach is to assume that CO_2 concentrations will increase by 1% per year (a better estimate would be lower, perhaps 0.5%) and other long-lived greenhouse gases will not change. The overestimate of CO_2 increase roughly cancels the underestimate of increases in other greenhouse gases. Using this approach and including the cooling effects of sulfate aerosols, several different groups around the world have performed simulations of future climate change. When those results are extracted for the PNW, the models give an average warming of about 5°F. Almost all of them also show increases in winter precipitation, and most show decreases in summer precipitation.

Q: What impacts would those changes have?

A: Perhaps the most significant impact would be a reduction in snowpack. A warming of 5°F would raise the snowline by about 1500 feet, dramatically reducing the area covered in snow. The significance of such a reduction comes because the Northwest's ecosystems and many human endeavors (including irrigation and urban water supply) rely on snowmelt to provide water during the region's characteristically dry summers. Our hydrological modeling work suggests that there would be a 30-40% reduction in summer flow in the Columbia River, which would require huge reductions in present uses like irrigated agriculture. The region's forests and salmon would generally suffer, especially if the pace of climate change is rapid. Agriculture would face both challenges and opportunities: challenges as irrigation water becomes scarcer, and opportunities for some crops that would benefit from a warmer climate and higher CO_2. Overall, these changes

will be very significant for many ecosystems, and pose a difficult challenge for natural resource management in the PNW.

Q: How might climate changes in the PNW affect the region's hydropower system?

A: It will be helpful to refer to Figure 7 in Exhibit PWM-1, which shows month-by-month streamflow of the Columbia River at the Dalles, Oregon. Climate change is very likely to lead to increases in winter streamflow for the Columbia and virtually every other river in the PNW, owing to rising temperatures and increasing precipitation, and would increase hydropower production in winter when demand in the PNW is greatest. However, as I just mentioned, summer streamflow is likely to drop 30-40% in the Columbia; more rain-dominated basins, like those on the west side of the Cascades, will see smaller drops. Because of the uncertainties introduced by deregulation and the higher priority given in water resource management to ecosystems (especially salmon), it is impossible to predict whether lower streamflow will make it more difficult to meet regional demand. However, it is fairly clear that climate change will lead to significant conflicts over water.

Q: If greenhouse gas emissions proceed at a rate slower than the 1% used for the modeling work you described, how would your previous answers change regarding impacts on the region?

A: Obviously, if a particular concentration of CO_2 is not reached until, say, 2060 instead of 2050, the pace of change would be slowed. A slower rate of change would allow more adaptation time for ecosystems and human management of natural resources.

Q. Does the potential for future impacts as you describe warrant action to reduce CO_2 emissions?

A. Local CO_2 emissions have global impacts, so we have to consider more just the impacts on the PNW. The question cannot be properly answered within the realm of science, only (in

a very narrow fashion) within the realm of economics or (more broadly) within the realm of morality. Because local CO_2 emissions affect global climate, the question really must be answered from a global perspective. Here's a small sampling of what science (IPCC report, WGII, 1995) says about the global impacts of climate change:

a) "The composition and geographic distribution of many ecosystems will shift as individual species respond to changes in climate."

b) Agricultural productivity will probably increase at high latitudes and decrease at low latitudes, but "the world's poorest people...are most at risk of increased hunger."

c) Sea-level rise poses a long-term threat to many low-lying communities, and "the most vulnerable human settlements are located in damage-prone areas of the developing world..." Sea-level rise will continue long after the concentration of CO_2 in the atmosphere is stabilized, lending urgency to early reductions in CO_2 emissions.

d) "Climate change is likely to have wide-ranging and mostly adverse impacts on human health..."

Economics can attempt to quantify monetary gains and losses of b) and c), but only by making a very large number of very significant assumptions, and the result is likely to be inaccurate, incomplete, and unsatisfactory, since the values we place on ecosystems and our own health cannot fully be evaluated in an economic context. In fact, I believe that this issue cannot be properly addressed from the realm of economics, but instead must be considered as a moral issue. As is suggested by points b) and c), and also (as is clear in the IPCC report) d), the positive impacts of climate change accrue disproportionately to wealthy, high-latitude countries, while the negative impacts fall disproportionately (as with

natural disasters, pollution, wars, epidemics, and a host of other ills) on the poorest countries, which are worst equipped to deal with them.

Hence, the question of whether to reduce greenhouse gas emissions is ultimately a question of international (and intergenerational) justice. Science can help frame the terms of the debate, but cannot in the end answer such a question. Reducing greenhouse gas emissions now means buying time, decades hence, to help poor countries and poor people reduce their vulnerability to the worst impacts of climate change.

Q: Does this conclude your testimony?

A: Yes.

END OF TESTIMONY

I declare under penalty of perjury that the above testimony is true and correct to the best of my knowledge.

DATED: June 16, 2000

By:_____

Philip W. Mote